Assignment 1 **Due Date: 4:00 pm Thursday, February 04, 2016**

(10) 1- Solve the last problem of the laboratory 1.

(25) 2- The acceleration of an object over an inclined plane can be estimated using the following equation:

$$a = \frac{m\ g\ sin\theta - F}{m}$$

where a is the acceleration, m is the mass, θ is the angle of the inclined plane and F is the friction force. Using various measurement instruments, the following values are measured for m, θ, and F considering the uncertainties associated with each measurement device. Estimate the error of the acceleration and report a range for its value. The gravity acceleration can be considered as a constant $g = 10\ m/s^2$.

($\boldsymbol{\theta}$ is in radian).

$m = 50 \pm 1\ kg$

$\theta = 0.5 \pm 0.005\ rad$

$F = 100 \pm 1\ N$

(40) 3- Consider the following function (***t* is in Radian**):

$$f(t) = \frac{1}{t} + \sin(t)$$

a- Approximate the value of $f'(t)$ at $t = 2$ using Backward, Forward and Central schemes. Use the step size $\Delta t = h = 0.1$.

b- Calculate the approximate relative error of Backward and Forward methods respect to the Central scheme.

c- Calculate the true relative error for Central scheme.

d- Determine the new step size for which the error of Central scheme becomes 50 times smaller.

e- Approximate the value of $f(2)$ using a first order method with $\Delta t = h = 0.1$.

f- Calculate the condition number of the function $f(x)$ at $t = 2$.

(25) 4- Consider the following function:

$$f(x) = e^x - \frac{1}{x^2}$$

Use the bisection method (three iterations) with $[0.68, 0.72]$ as the first interval to find the solution. Estimate the approximate relative error in second and third iterations (convergence criterion).